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DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

313. Proposed by W. J. GREENSTREET, M. A., Stroud, England.

Find the conditions that the equations $px^2+qx+r=0$ and $\alpha x^2+\beta x+\gamma+y(ax^2+bx+c)=0$ may give equal values for y.

Solution by G. W. HARTWELL, University of Kansas, Lawrence, Kansas.

$$px^2+qx+r=0\ldots(1).$$
$$\alpha x^2+\beta x+\gamma+y(ax^2+bx+c)=0\ldots(2).$$

Since (2) is of the first degree in y, the values of y will be equal when the roots of (1) are equal.

$\therefore q^2-4pr=0$ is one condition that (1) and (2) give equal values of y.

If $q^2-4pr\neq0$, we have on solving (1) and substituting in (2),

$$y=-\frac{\alpha q^2-2\alpha pr-\beta pq+2\gamma p^2\pm(\beta p-\alpha q)\sqrt{(q^2-4pr)}}{aq^2-2apr-bpq+2cp^2\pm(bp-aq)\sqrt{(q^2-4pr)}}\ldots(3).$$

The two values given by (3) will be equal when,

$$(bp-aq)(\alpha q^2-2\alpha pr-\beta pq+2\gamma p^2)$$
$$-(\beta p-\alpha q)(aq^2-2apr-bpq+2cp^2)=0\ldots(4).$$

(4) can be put in the form:

$$p^2\begin{vmatrix} p & q & r \\ a & b & c \\ \alpha & \beta & \gamma \end{vmatrix}=0.$$

$\therefore$ The conditions that (1) and (2) give equal values of y are

I. $q^2-4pr=0$. Or, II. $\begin{vmatrix} p, & q, & r \\ a, & b, & c \\ \alpha, & \beta, & \gamma \end{vmatrix}=0$. Or, III. $p=0$.

In this case (1) becomes an equation of the first degree, and hence (2) can give only one value of y.

Also solved by V. M. Spunar.